DISTORTION IN THE STRATIGRAPHY AND BIOSTRATIGRAPHY OF TIMOR, A HISTORICAL REVIEW WITH AN ANALYSIS OF THE CRINOID AND BLASTOID FAUNAS

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Permian fossils have been known from Timor since the latter part of the 1800s. The generally accepted ages of the ammonoid faunas, recognised in the early 1900s from West Timor, are early Sakmarian, Artinskian, early Wordian, Wordian and Wuchiapingian. These ages have been applied to all invertebrates from Timor, although the other invertebrates are known to occur in strata without ammonoids at some localities. At other localities where ammonoids and other invertebrates have been reported there is no known stratigraphy. Biostratigraphy of the invertebrates cannot be fully resolved until the stratigraphy of each of the major localities of Timor is known in detail.

Crinoids and blastoids reported from nearly 100 localities are used to demonstrate the biostratigraphic problems recognised on Timor. The Bitauni echinoderm fauna is Artinskian based on conodonts. Echinoderm faunas from the vicinity of Basleo, Timor are, in part, correlated with Artinskian, echinoderm faunas in Western Australia, Oman and Russia. Other parts of the Basleo faunas are possibly Wordian and Wuchiapingian by correlation with eastern Australia and North and South America. The Amarassi fauna contains the youngest Permian crinoids known from cups and crowns.

Earlier interpretations of a Late Permian range for all crinoid genera and a Permian range for all blastoid genera from Timor are in error. The above statements may apply to other non-ammonoid invertebrate faunas from Timor.

SINCE the early studies of the West Timor invertebrate faunas in the first half of the 1900s their age has commonly been cited as Late Permian (J. Wanner, numerous papers 1911–1949; Bassler & Moodey 1943; Moore & Teichert 1978; among others), although faunas from some localities were known to be of Early Permian age (Schubert 1915; Burck 1923; Thompson 1949). Ages assigned to the invertebrates were based on ammonoids from the same locality. In many instances specimens were retrieved from the regolith in areas of high relief, with no stratigraphic control (Burck 1923). Many specimens were purchased with no verification of the locality, if known. In addition, some localites were vaguely defined, such as the site of a hut or village.

The range of Permian crinoid genera from Timor has been extended through the Late Permian (Moore & Teichert 1978) to show massive extinctions at the end of the Permian even though the age was not initially cited as latest or even Late Permian for some genera. Blastoid genera from Timor were assigned a range of Permian (Moore 1967), when some genera were known to be from a single locality and a spot age within a stage. The incorrect age designation and extension of the ranges above and below the horizon of occurrence may have produced extensive inaccuracy in the interpretation of Permo-Triassic boundary extinctions and first and last occurrence tabulations.

The purposes of this paper are: (1) to review the literature of Permian stratigraphy on Timor; (2) to examine stratigraphic relationships of the non-ammonoid invertebrates to ammonoids at localities with stratigraphic control; (3) to review interpretations of the age of Timor echinoderm faunas; and (4) identify problems and correlations with other faunas worldwide.

HISTORY

1862–1950

The invertebrate faunas of West Timor were initially reported and considered Carboniferous by Beyrich (1862); subsequently they were recognised as Permian by Rothpletz (1892). However, the faunas remained poorly known until expeditions of J. Wanner in 1909 and 1911, G. A. F. Molengraaff in 1910–1911, J. Weber in 1911 and H. G. Jonker in 1916 acquired large collections of abundant, diverse and remarkably well preserved specimens (Schubert 1915; Haniel 1915; J. Wanner 1926). Additional collections were obtained by a field class from the Geological Institute, University of Amsterdam, led by H. A. Brouwer in 1937 when the Spanish Civil War prevented field studies in Spain (Brouwer 1942). Most of these collections are housed at Delft and Leiden, The Netherlands. Another large collection of the Timor echinoderms is at Bandoeng, Indonesia, and contains a reported 22 500 specimens of echinoderms (Wanner 1929). Worldwide, numerous trade and purchased specimens of the Timor invertebrates are in various museums and university collections.

More than 100 localities yielding invertebrates have been reported from Timor. Schubert (1915) listed 17 foraminifera localities, with one probable duplication; Broili (1916) reported 74 brachiopod localities; and Gerth (1927) identified 42 coral localities. J. Wanner (1924a) cited 38 crinoid localities from nine districts in West Timor and one locality from East Timor. Although there is some locality duplication among these various reports, the major locality in each is the Basleo area. J. Wanner (1926) stated that over 90% of the crinoid species and 75% of all the remaining invertebrate faunas of Timor were reported from the vicinity of Basleo (Appendix, loc. 1). Wanner (1924a) considered many of the localities to be inadequately collected.

Basleo localities 2 through 6 were reported to be in a red-brown or yellow marl and 7 through 9 from a greenish tuff (Appendix). These were the richest crinoid-producing localities separately designated in the Basleo area. A similar locality register was given for the 37 blastoid localities, when J. Wanner (1924b) also reported an additional crinoid from a conglomerate in the Basleo area. Thus three crinoid-bearing lithologies are known from the Basleo area, but the lithologies of the bulk of the Basleo specimens are unknown. Combining duplicates, 56 localities from West Timor and one from East Timor yielded Permian crinoids and blastoids (Wanner 1924a, 1924b). Wanner (1931a) reported 28 ammonoid localities from the Basleo region and 23 of these also yielded crinoids. Wanner (1931a) considered all Basleo fossils to come from the same horizon and to be of the same age, Late Permian. Later, Wanner (1937, 1940) described new camerate crinoids and the inadunate, *Timorocidaris*, from 16 localities in the Basleo area that are in part the same as earlier reported localities, but specific locality information is lacking for a number of the specimens and some possible duplication cannot be verified.

Bassler and Moodey (1943), summarising the Timor Permian crinoid and blastoid faunas, listed 42 localities, many in the Basleo Region. They did not recognise the different Dutch and German spellings for the same locality in various publications and thus Toenioen Eno and Tuniun Eno are cited as different localities. Comparison of the more than 100 reported localities by various authors shows some locality duplication. Some of the same localities, especially those yielding the most diverse and abundant specimens, were collected by more than one of the expeditions to Timor (Burck 1923). It is also possible that some localities collected by different parties of the Timor expeditions have been given different names and specific geographic information is insufficient to recognise them as duplicates. Listed in the Appendix are a compilation of the localities cited by Wanner (1924a, 1924b) followed by localites given by Bassler & Moodey (1943) and Wanner (1937, 1940) that do not match the earlier citations.

A majority of the localities (43 of the 57 of Wanner 1924a, 1924b; 23 of the 35 of Wanner 1937, 1940; and Bassler & Moodey 1943) have three or fewer species reported from them. Although these localities are important for a complete understanding of the Timor stratigraphy they contain few species not reported from other localities. Most of these localities are considered inadequately collected as suggested (Wanner 1931) and are not discussed in detail herein.

Initial interpretations of the Permian age of the Timor faunas were mixed. Schubert (1915), Marez Oyens (1940) and Thompson (1949) considered the fusulinids from several localities including the Basleo area to be of Early Permian age. Broili (1916) recognised several brachiopod faunas representing multiple levels but did not specify stages in the Permian. Bather (1914) and Springer (1920, 1924) thought parts of the echinoderm faunas suggested a possible Carboniferous age in contrast to the Middle Permian age assigned by Wanner (1924a, 1924b). C. Wanner (1922) considered the gastropods and bivalves to be Early Permian. The corals (Gerth 1921) and sponges (Gerth 1927) were interpreted as of unspecified Permian age.

Haniel (1915), noting the particular abundance of the Bitauni faunas, interpreted five horizons based on ammonoids from Timor: three in the Early Permian, one (Basleo) on the boundary of the Early and Late Permian and one in the Late Permian. Smith (1927) considered the ammonoids to represent two Early and two Late Permian faunas. Wanner (1931a) reviewed the ammonoid occurrences and reported an Early Permian age for the Somohole and younger Bitauni faunas, a Late

Permian age for the Basleo faunas, and an even younger Late Permian age for the Amarassi faunas. Marez Oyens (1938) and Simons (1940) suggested subdivision of the Bitauni faunas was possible. Brouwer (1942) thought that six ammonoid faunas could be recognised with further subdivision of the Bitauni and Basleo faunas. Gerth (1950) recognised five major faunas, three Early and two Late Permian and believed that the two oldest could be subdivided into additional faunas.

Large parts of the Timor faunas were described in *Paläontologie von Timor* edited by J. Wanner (1914–1929) and the remainder in numerous publications in various journals (Gerth 1927; among others). Although elements of the early collections remain to be described, major contributions were essentially completed with the description of some of the poteriocrinid crinoids by Wanner (1949) and additional ammonoids by Gerth (1950). In all of these systematic descriptions, stratigraphic position and other details are not given, only a locality reference provides moderately specific geographic position on Timor (Fig. 1).

1950–present

Regional and worldwide reviews of Permian fossils have commonly included elements of the Timor faunas (Teichert 1951; among others). The discovery of new Permian fossils in various parts of the world have often made comparisons to, or required revision of, elements within the Timor faunas (Teichert & Glenister 1952; among others). Timor brachiopods, crinoids and ammonoids have been used for correlation, in preference to other invertebrates. Grant (1976) recognised four Timor brachiopod faunas corresponding to the four ammonoid faunas of Wanner (1931a), namely:

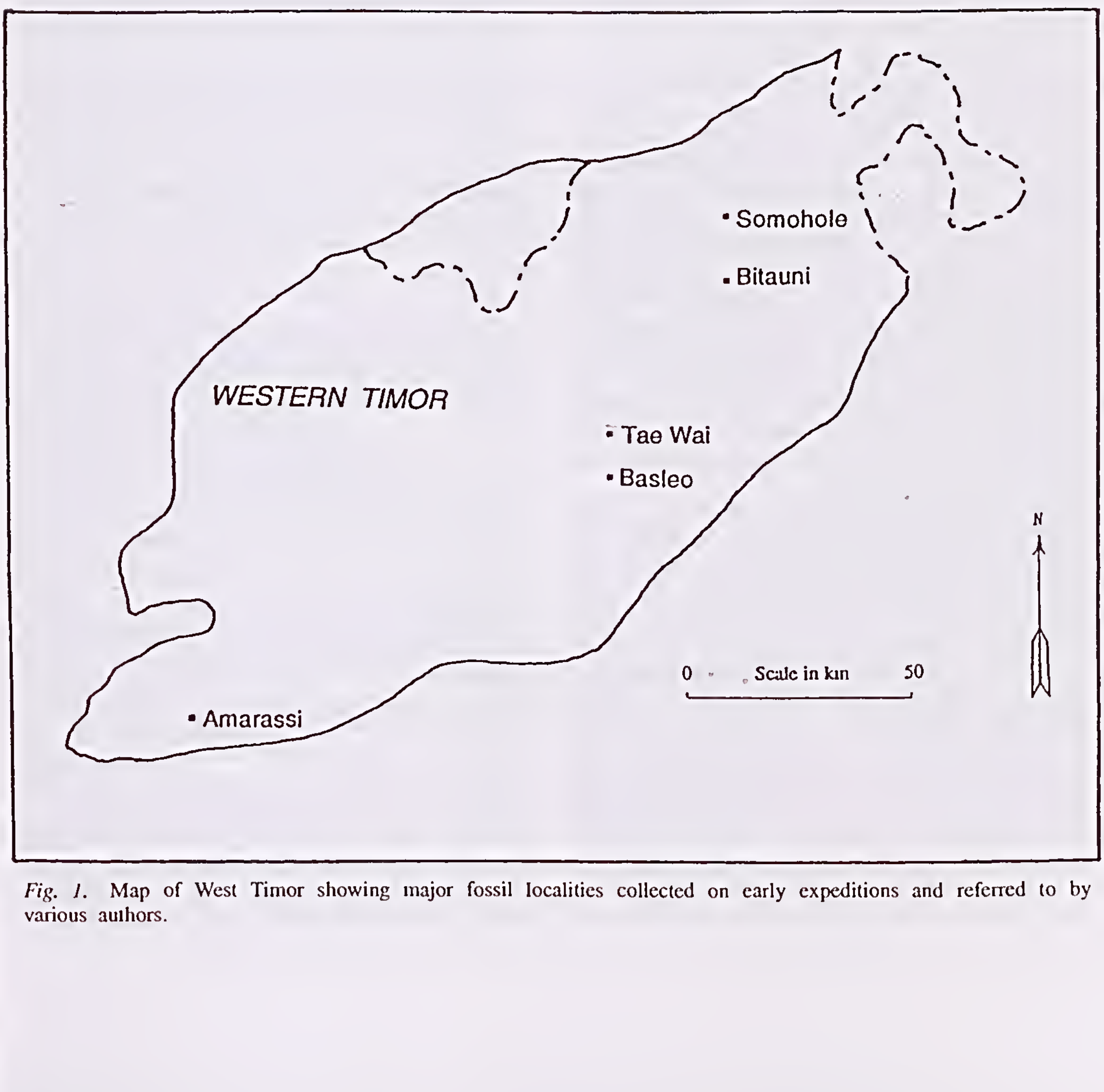

Fig. 1. Map of West Timor showing major fossil localities collected on early expeditions and referred to by various authors.

Somohole, late Asselian–Sakmarian; Bitauni, lastest Sakmarian through Artinskian; Basleo, Kazanian; and Amarassi, lastest Kazanian–Dzhulfian. Waterhouse (1981) considered the Bitauni brachiopods to be Kungurian. Two brachiopod faunas from the Maubisse Formation in West Timor were considered, Sakmarian (Archbold & Barkham 1989) and Chiddruan (Archbold & Bird 1989). Some of these specimens were collected from soil horizons, but most were collected *in situ*. Crinoid rich beds were reported to be dolomites and non-reefal in Archbold & Bird (1989) and calcarenites and calcarenites with calcareous shales in Archbold & Barkham (1989). No crinoids or ammonoids were identified in their reports.

Few ammonoids have been described from Timor since 1950. However, studies of Permian ammonoids from different parts of the world have included descriptions of a few new taxa and reallocation of others from Timor (Saunders 1971; Glenister & Furnish 1988). The abundance and diversity of the Somohole and Moetis ammonoid faunas were briefly discussed by Furnish & Glenister (in Saunders 1971).

Modern studies of the Permian ammonoids of Timor agree with earlier studies, that is, more than one fauna is present and that more than one fauna may be present at some localities. Glenister & Furnish (1987) reported a Sakmarian age for the Somohole, Artinskian for the Bitauni, Wordian for the Basleo and Amarassian for the Amarassi faunas. This corresponds to Grant's (1976) four brachiopod faunas, differing only with the Basleo brachiopods considered Kazanian by Grant (1976)—perhaps only a semantic difference. Glenister & Furnish (1987) also reported one Amarassian type ammonoid from the Basleo area. This provides additional support for the earlier interpretation of Smith (1927) that more than one ammonoid fauna occurs in the Basleo area.

Conodonts recovered from ammonoid matrix materials and *in situ* blocks from the Jonker and Brouwer collections at Bitauni and the Moetis region are Artinskian (Boogaard 1987). He found abundant specimens in matrix material around ammonoids but sparse in the crinoidal pink limestone that was given as stratigraphically below the ammonoid beds (Boogaard 1987). The stratigraphic sequence at Bitauni is inverted and the pink crinoidal limestone is stratigraphically above the ammonoid beds (Burck 1923) as discussed below. Boogaard (1987) mentioned that small ammonoids occur rarely in the pink limestone, but did not identify them or discuss their age relationships.

Regional and intercontinental correlations in other parts of the world are often related to the Timor ammonoids as a world standard (Glenister & Furnish 1988). This is somewhat surprising, given that Timor exposures lack a good continuous stratigraphic section, among other problems. The Somohole and younger Bitauni ammonoid faunas are correlated to equivalents in Western Australia, the type Sakmarian and Artinskian of Russia and the upper Wolfcampian and Leonardian of west Texas. The Basleo fauna is correlated with faunas from the Sosio Limestone of Sicily, Djebel Tebaga of Tunisia and Wordian of west Texas. Amarassian ammonoids are correlated with equivalents in Western Australia and India.

STRATIGRAPHY

It has often been stated that the Timor faunas are derived from isolated blocks and that there is little or no stratigraphic or structural control known for the faunas (Wanner 1931a; De Roever 1940; among others). Much of the material was indiscriminately collected, often from soil horizons, and some came from local inhabitants who brought loose-weathered specimens from undesignated or loosely defined localities to the field parties for purchase (Burck 1923; Wanner 1931a). Furnish & Glenister (in Saunders 1971) noted that the Somohole fauna, in the low-lying area of northern Timor, occurs in a distinctive, fairly dark weathering tuff, and lacks the admixing common in high relief areas to the south. Furthermore they commented (*op. cit.* p. 102) 'One of the problems inherent in use of Timor collections is the lack of a stratigraphic sequence. That is most of the fossils have been found loose on the weathered surface in areas of high relief, where structural complexity makes an exact source uncertain and obvious mixing has taken place.' Specimens continue to be indiscriminately collected by local residents, for sale in Timor (B. Macurda, pers. comm.), and are available from commercial dealers in Europe and North America.

References to different lithologic types from the same or different localities in Timor are made in discussions of specific types of fossils. It is often emphasised that only one type of fosssil is found in certain limestones. For example, Gerth (1921) described different matrix colors and lithologies associated with species of corals from the same and different localities in Timor. As discussed above J. Wanner (1924a, 1924b) reported crinoids from three lithologies in the Basleo region. Fusulinid-rich limestones or coquinas are mentioned by Schubert (1915), Burck (1923) and Brouwer (1942) and shown in illustrations by Thompson (1949: pl. 34, fig. 1; pl. 35, fig. 7). Ammonoid specific beds or horizons at Somohole, Bitauni, Basleo and Amarassi are listed by Burck (1923), J. Wanner (1931a), among others. J. Wanner (1931a: 542) referred to banks dominated by corals, blastoids, ammonites or brachiopods and the prevalence of certain species at certain localities in the Basleo area. Furthermore (p. 543), he considered these to be of the same age value for local classification but insignificant for interregional stratigraphy. These references to different matrix colors, multiple lithologies and fossil specific lithologies indicate that a stratigraphy, with facies control of most fossils, is developed throughout the Permian of Timor. The echinoderms and ammonoids are normally not found in the same stratigraphic layer, although Haniel (1915) mentioned sporadic crinoid cups in ammonoid limestone from Bitauni.

Unquestionably, there is a definite lack of stratigraphic and structural control for large parts of the fossil collections. However, Burck (1923) gave general stratigraphic information for several localities that were located on drainage maps of local areas in West Timor. These included each of the major areas from which crinoids and ammonoids are known.

There is no known stratigraphic section at Somohole (Burck, 1923). In the Soefa region, north of Somohole (equal to the Bitauni section), Burck (1923) reported three Permian levels below the Triassic:

Triassic limestone
Productus level (in red-weathering limestone)
Bryozoan level (in yellow-weathering ferruginous limestone with brachiopoids, corals, crinoids and, rarely, trilobites)
Ammonoid level (in limestone).

At Bitauni the stratigraphic sequence is overturned (Burck 1923), but the three Permian units recognised are:

Triassic limestone
Marl, yellow brown with abundant brachiopods
Limestone, pink, white stippled, bryozoan rich with crinoids, brachiopods and few small ammonoids
Marl, grey-green, weathers brown-red, tuffaceous, rich ammonoids.

This section is basically the same as at Soefa, except ammonoids are known in the pink limestone with the crinoids. Differences in the limestones between the two areas are attributed to microfacies.

In the Niki Niki–Basleo region Burck (1923) recognised numerous localities with most listed as diabase tuff with fossils and noted the best localities were weathered soils with lag fossil concentrates. Furthermore, at Netoe Kot he showed (*op. cit.* fig. 9) yellow-brown limestone with two or more horizons specific to ammonoids or lamellibranchs in each of three exposed blocks.

At Fatoe Koeat in the Amarassi region Burck (1923) recognised seven units:

Crinoidal limestone with good brachiopods
Brachiopod and bryozoan limestone with a few compressed cups of crinoids
Crinoidal limestone
Lamellibranch limestone
Ammonoid limestone
Diabase and tuff
Crinoidal limestone with a few loose pieces with ammonoids.

It is clear from the summary descriptions given by Burck (1923) that a stratigraphic sequence is developed in each of the major fossil rich regions. The Basleo region is the least understood, yet yields the most fossils.

Of special significance for understanding the crinoid distribution and stratigraphy of Timor is Burck's (1923) report of the repeated occurrences of 'trocheitenkalk', or as translated, crinoidal limestone, and other fossil specific lithologies which yield only ammonoids or bivalves with no crinoidal material. Typically it is not stated whether the crinoidal limestones yielded cups and crowns or only stem segments and disarticulated ossicles.

Brouwer (1942) named four stratigraphic series, each containing Permian rocks. Five stratigraphic levels, based on ammonoids, within the Sonnebait Series are the informal Somohole, Bitauni, Tae Wei, Basleo and Amarassi beds. An informal Lidak zone was designated as equivalent to the lowest part of the Bitauni beds.

In early descriptions of the invertebrate fossils, except for mention of fusulinid limestone, ammonoid coquina, etc., limited stratigraphic details were provided at best. As crinoids, blastoids, ammonoids, brachiopods and other fossils have been reported from the same locality, an age determined for the ammonoids, has typically been applied to all fossils from that locality. The conflicting age interpretations, based on different fossil groups, by early workers and stratigraphic information provided by Burck (1923) were unrecognised or disregarded in later evaluations of the faunas and few attempts (Archbold & Barkham 1989; Archbold & Bird 1989) have been made to establish a biostratigrahic framework for the Permian of Timor except the ammonoid zonation.

With modern tectonic studies of Timor and the surrounding region (Grady & Berry 1977; Berry & Grady 1981; Audley-Charles 1965, 1968; Charlton et al. 1991; among others) sedimentological and stratigraphic details are being given proper perspective. Audley-Charles (1965, 1968) designated the Maubisse Formation, noting that it included the highly fossiliferous Permian strata assigned to the Sonnebait Series. Mapping of local areas in Timor has identified stratigraphic units within the Maubisse Formation (Archbold & Barkham 1989; Archbold & Bird 1989). Until the stratigraphy of each of the Timorese localities is known, the biostratigraphy may have to be resolved by correlations outside Timor.

FAUNAL DISTRIBUTIONS AND COMPARISONS

Of known Permian crinoids worldwide Timor has the largest number of genera (97) and species (237). The faunas contain 12 genera, 34 species and three subspecies of camerates; 71 genera, 162 species and 24 subspecies of cladids; 11 genera, 36 species and 12 subspecies of flexible crinoids and three genera and five species of indeterminate crinoids (Bassler & Moodey 1943; Webster, unpub. compil.). In addition, 16 genera of blastoids are known from Timor (Moore 1967; Breimer & Macurda 1972; Waters 1990). Nearly two-thirds (63 of 97) of the crinoid genera and 11 of 16 blastoid genera are unknown outside Timor. Although a modern study of the 10 species of *Timorechinus*, 18 species of *Calycocrinus*, eight species of *Actinocrinites*, multiple designated species of several other genera, and all of the subspecies would probably result in a reduction of the total number of species and subspecies, there is no question that the Timor echinoderm fauna is highly diverse. The poteriocrinoids are most diverse and the flexibles attain their third and final diversity high in the Permian of Timor. Blastoids attain their second greatest diversity in Timor (Breimer & Macurda 1972; Waters 1990).

Early descriptions of the Timor crinoids and blastoids suggest at least seven to 10 echinoderm horizons. In ascending order, these are Somohole, Bitauni, Tae Wai, three at Basleo and one to four at Amarassi. Each of these localities has yielded abundant ammonoids and been collected by more than one expedition in the first half of the Twentieth Century. Four other localities have yielded significant crinoid specimens of more than five species. There are other horizons or facies of the same or different ages among the numerous localities in Timor from which only one to four crinoid and or blastoid species are reported. Many localities are inadequately known and most may be insufficiently collected. Each of the major localities is discussed separately.

Somohole

The Somohole (Appendix, loc. 49) fauna has 50% blastoid genera compared to the other major echinoderm faunas of Timor, none of which has more than 40% and most range between 11 and 20%. The Somohole echinoderm fauna contains only one species, *Mollocrinus poculum*, known from the Basleo fauna, as all other species are restricted to the locality. Four genera (*Coenocystis*, *Neolageniocrinus* [=*Lageniocrinus*], *Sphaeroschisma* and *Calycoblastus*) are restricted in the Permian to Somohole, whereas five genera (*Neoplatycrinus*, *Eutelecrinus*, *Anthoblastus*, *Nannoblastus* and *Deltoblastus*) are known from the Basleo fauna. *Eutelecrinus* and *Deltoblastus* are also known from the Amarassi faunas. The fauna contains only one genus, *Neoplatycrinus*, in common with the late Sakmarian–early Artinskian Callytharra Limestone of Western Australia and *N. somoholensis* is closely related to *N. callytharraensis* (Webster & Jell 1992) suggesting similar age.

Deltoblastus is the most common blastoid and one of the most common echinoderms in Timor. Waters (1990) reported that it is known from tens of thousands of specimens. *Deltoblastus* is known from most localities in the Basleo and Amarassi districts as well as from a few other localities in other districts. No modern analysis of the genus has been done and there are probably several synonyms in the 13 species and six subspecies described by Bather (1908), Wanner (1910, 1924) and Jansen (1934). *Deltoblastus* was reported from India (Gupta & Webster 1976) but that report is now considered to be one of Gupta's many fabrications (Webster 1991). An unreported late Sakmarian–early Artinskian *Deltoblastus* specimen is known from Oman and Waters (1990) reported a questionable Wordian *Deltoblastus* from Sicily. An Asselian–Sakmarian age was assigned to *Sphaeroschisma* and *Nannoblastus* by Breimer & Macurda (1972) and Macurda (1983), accepting the ammonoid age previously assigned to the Somoholo fauna.

Coenocystis is a Late Carboniferous holdover and *Neolageniocrinus* (=*Lageniocrinus*) is an Early Carboniferous holdover, both from North America. Eutelecrinids closely related to *Eutelecrinus* occur in the Wordian Sosio Limestone of Sicily (Arendt 1978). Except for *Coenocystis* and *Neolageni-*

ocrinus all Somohole echinoderm genera are indigenous or known from localities considered younger than the ammonoid fauna.

No stratigraphy relating the echinoderms and ammonoids is known at Somohole. The Somohole ammonoids are considered late Asselian–early Sakmarian, most likely the latter (Glenister & Furnish 1987). The echinoderms suggest a late Sakmarian or early Artinskian age or younger when compared to other Permian faunas as noted above.

Bitauni

According to Haniel (1915) and Burck (1923) two crinoid and ammonoid bearing horizons are present at Bitauni. The lower ammonoid rich beds Artinskian (Wanner 1931; Gerth 1950; among others) and the overlying beds are now also dated Artinskian, based on conodonts (Boogaard 1987). It is unknown if the ammonoids and crinoids are described from both beds or the ammonoids from the underlying ammonoid rich beds and the crinoids from the overlying more crinoidal rich beds. In either case, an Artinskian age is accepted for the crinoids from Bitauni.

The three Bitauni crinoids identified are all known from the general Basleo faunas, suggesting that some of the Basleo faunas may be of Artinskian age.

Soefa

The Soefa fauna (Appendix, loc. 50) has a single crinoid, *Embryocrinus hanieli*, in a grey marl. This taxon is widespread in the Basleo fauna. The ammonoids from Soefa are considered equal to the Bitaui fauna and the stratigraphic section from Soefa reported by Burck (1923) is essentially the same as for Bitauni, except no ammonoids are known from the crinoidal horizon in the bryozoan rich limestone above the ammonoid limestone.

Nefotassi

Ammonoids from Nefotassi were considered equivalent to the Bitauni ammonoid faunas and of Artinskian age (Glenister & Furnish 1987; among others). There is no stratigraphic section known for the locality. It is unknown if the crinoids are from the same horizon as the ammonoids, above the ammonoids, or both in the same horizon and above the ammonoids as at Bitauni. The Nefotassi fauna contains three crinoid species restricted to the locality (Appendix, No. 53). Two other unidentified forms may also be restricted to the locality. *Parabusacrinus nefotassiensis* is also known from the Callytharra Formation, Western Australia, and all genera, as well as *Monobrachiocrinus granulatus*, are known from the Basleo fauna.

Calceolispongia digitata and *C. spinosus* from Callytharra Springs, Western Australia, are smaller and more ornate than the Nefotassi species, *C. mammeatus*. This may represent geographic differences. However, late Artinskian species of *Calceolispongia*, from the Wandagee Formation, Western Australia (Teichert 1949), show progressive enlargement of the crown with extensive protrusion of the basals (much larger than developed on *C. mammeatus*). A slightly younger age, middle Artinskian, for the Nefotassi fauna is suggested by *C. mammeatus*. A middle Artinskian age, supported by *P. nefotassiensis* in the Callytharra fauna, is tentatively assigned to the fauna, until stratigraphic details of the locality are known. The endemic species suggest a slightly different age or environment for the Nefotassi and Bitauni faunas.

Tae Wei

The Tae Wei ammonoids were considered equivalent to the Sosio, Sicily fauna (Gerth 1950) and placed between the Bitauni and Basleo faunas. Other interpretations of the ammonoids have placed the fauna equivalent to or in the lower part of the Basleo fauna (Haniel 1915; Wanner 1931; Glenister & Furnish 1987). The stratigraphy of Tae Wei is unknown (Burck 1923).

Tae Wei (Appendix, loc. 89) contains one genus, *Parasycocrinus*, and four species, restricted to the locality. Four genera, two crinoids, *Calycocrinus* and *Timorocidaris*, and two blastoids, *Timoroblastus* and *Pterotoblastus*, are known from the Basleo fauna. Three genera are known from Artinskian deposits outside of Timor. These are *Calycocrinus* from Krasnoufimsk, *Timoroblastus* from Oman (unreported), and *Pterotoblastus* from Thailand. *Calycocrinus labiatus* is in the Basleo fauna. By correlation of the crinoids with faunas from elsewhere a late Artinskian age could be assigned to them.

Dorf Sebot

Dorf Sebot (Appendix, loc. 41) contains 10 species and one subspecies of crinoids and three species of blastoids, all known from the general Basleo fauna. Several taxa are known from Artinskian deposits outside Timor. *Synbathocrinus campanulatus elongatus* (=*S. campanulatus*) is known from the Callytharra fauna. *Timoroblastus cornutus* is unreported, but known from late Sakmarian or early

	Total No. genera (world)	Percentage of world total	No. genera known in Timor	% Timor genera in Timor total	% Timor genera in world total
Camerates	17	9.88	12	12.37	70.58
Inadunates	136	79.07	71	73.29	52.20
Flexible	16	9.30	11	11.33	68.75
Indet.	3	1.74	3	3.09	1.74
Totals	172	100	97	100	56.35
Blastoids	18	100	16	100	88.88

Table 1. Comparison of Timor Permian crinoids and blastoids to world totals. Numbers do not include taxa based on columnals. Crinoid subdivisions follow usage of Moore & Teichert (1978).

Locality	Total described Genera	Total described Species	Common to Timor Genera	Common to Timor Species
Timor	97	237	97	237
Early Permian				
Tethys				
1. Callytharra	42	51	11	9
2. Krasnoufimsk	24	26	16	—
3. Wandagee	10	24	4	1
4. Crinoidal Zone	4	11	2	—
5. Wandrawandian	5	10	2	—
6. Timan	6	7	4	—
Non-Tethys				
7. Bird Spring	34	43	7	—
8. Cibolo	9	11	4	—
9. Copacabana	8	9	2	—
Late Permian				
All Tethys				
10. Djebel Tebaga	11	11	3	—
11. Sosio	10	10	5	—
12. Berry	4	9	1	—

Table 2. Summary list of Permian crinoid faunas giving total number of genera and species described from each and number of genera and species common to the Basleo Fauna. See Appendix for lists of identified genera and species and references for each locality; Timor lists in Section 1, all others in Section 2.

Artinskian deposits of Oman as is *Deltoblastus*. *Graphiocrinus* is known from Artinskian, or equivalent, deposits in Krasnoufimsk, Timan and the United States. *Monobrachiocrinus* is also known from Krasnoufimsk. *Graphiocrinus* and *Monobrachiocrinus* are known from the Wordian Sosio Limestone, Sicily, and *Embryocrinus* occurs in the late Wordian Djebel Tebaga fauna of Tunisia. Overall the fauna is most closely related to Artinskian faunas worldwide. However, stratigraphic details of the locality are unknown and it is uncertain if more than one fauna occurs. A late Artinskian to early Wordian age is tentatively assigned.

Basleo

Numreous echinoderm (Appendix, locs 1–14, 58–88) and ammonoid faunas occur in the vicinity of Basleo but there is no stratigraphy available for the region. A Wordian age has generally been applied to the Basleo faunas based on the ammonoids. The Late Permian age of the Timor crinoid faunas was questioned by Webster (1987, 1990) and Webster & Jell (1992, 1993). These authors suggested that the Timor faunas may be mostly Early Permian based on correlation with Western Australian crinoids, including some conspecific forms.

Worldwide, nearly 60 papers have described Permian crinoid cups and crowns, most reporting one to three species from one or more localities (Webster, unpub. compil.). Early Permian crinoids have been reported from a number of localities (Weller 1909; among others), whereas Late Permian crinoids have been reported from only a few (Lane 1979; among others).

Many of the Early Permian faunas are of low diversity or represent the preservation of a solitary specimen. Nine faunas with seven or more species are used for comparison with the Timor fauna (Table 1). Within these faunas specimens are common to abundant and preservation is good to excellent. The Early Permian age of each of these faunas is documented by associated fusulinids or ammonoids in the same bed or more commonly from the stratigraphic sequence containing the crinoids. The number of genera and species from these nine faunas, common with Timor, are listed in Table 2.

The two Early Permian faunas that correlate most closely with the Basleo faunas are those from the Callytharra Limestone, Western Australia, and Krasnoufimsk, Ural Mountains, Russia (Table 2). At the species level the Callytharra Limestone is most similar to the Basleo fauna with 9 species and 11 genera of crinoids and one species and three genera of blastoids in common. The

Krasnoufimsk fauna has 16 genera of crinoids and one genus of blastoids in common. The crinoid genera common to Basleo and Callytharra include six long-ranging taxa, four of which (*Actinocrinites*, *Cydonocrinus*, *Litocrinus* and *Camptocrinus*) are considered Mississippian holdovers in the south-eastern Tethys (Webster & Jell 1992). Species of the other two genera, *Platycrinites* and *Synbathocrinus*, have been reported from Pennsylvanian (Strimple et al. 1971; Bowsher & Strimple 1986) or Permian (Moore 1939; Webster & Lane 1967) strata in North America. *Calceolispongia*, *Parabursacrinus*, *Tapinocrinus* and *Timorechinus* are restricted to Tethys with the latter three genera known only from Timor and Western Australia. *Calceolispongia* ranges from the late Sakmarian–early Artinskian Callytharra Formation of Western Australia (Teichert 1949) to the Roadian Crocker Formation of Queensland (Willink 1979b) and is also reported from Artinskian deposits of India (Reed 1928; Teichert 1949). *Apographiocrinus* is also described from Pennsylvanian and Permian strata in North America (Moore & Plummer 1940; among others), late Carboniferous, Westphalian, strata of Morocco (Termier & Termier 1950), and late Sakmarian to early Artinskian strata of Thailand (Webster & Jell 1993).

Eleven of the 16 genera common to Basleo and Krasnoufimsk are restricted to the Tethys in the Permian (Table 2). The other five are all known from North America and two of these, *Delocrinus* and *Cibolocrinus*, are also known from South America (Burk & Pabian 1978; Strimple & Pareyn 1982). The Krasnoufimsk and Callytharra Limestone faunas have only one genus in common, *Neocamptocrinus*–*Camptocrinus*, although it is very likely that they also have *Platycrinites* or *Neoplatycrinites* in common, as both are known to have columnals of the *Platyplateium* type (Yakovlev, in Yakovlev & Invanov 1956; Webster & Jell 1992). As might be expected the Laurentian realm faunas have fewer genera in common with Timor, whereas some Tethys realm faunas (Callytharra Formation and Krasnoufimsk, Russia) show significant numbers of related genera and two faunas (Callytharra and Wandagee Formations) contain one or more taxa conspecific with Basleo taxa. Thus, comparison of the nine Early Permian faunas with the Basleo fauna suggest that some of the Basleo fauna is of Artinskian age.

Late Permian crinoid faunas documented with associated fusulinids or ammonoids are few. Most faunas are of low diversity and abundance. Except for the previously considered Basleo fauna, no Late Permian fauna is as diverse as the Early Permian Callytharra or Krasnoufimsk faunas.

Three Late Permian faunas, each with nine or more species, were compared to the Timor faunas (Table 2). The eight genera known from Basleo and one or more of the other three faunas are: the camerate *Neocamptocrinus* (=*Camptocrinus*); the six inadunates *Basleocrinus*, *Embryocrinus*, *Graphiocrinus*, *Monobrachiocrinus*, *Stachyocrinus* and *Stuartwellercrinus*; and the flexible *Cibolocrinus*. Of these, *Graphiocrinus*, *Stuartwellercrinus* and *Cibolocrinus* are also known from the Laurentian realm; all others are restricted to the Tethys realm. Only *Neocamptocrinus* is known from the Late Permian, Wuchiapingian, all others are known only from Wordian or older strata. All of these taxa support a Wordian age for some Basleo faunas.

Permian crinoids and blastoids follow Van Valen's law, that is, most genera are short lived and a decreasing number extend through a longer time span, i.e. 60 of the 97 genera known from Timor are restricted to the Basleo fauna. These 60 restricted genera and three other genera of uncertain affinities are currently of little value for dating or correlation of the Basleo faunas.

Of the 34 crinoid genera reported from, but not restricted to Timor nine genera are reported from the Laurentian and Tethys realms. The other 25 genera are restricted to the Tethys. The nine unrestricted genera are: the camerate *Platycrinites*; the seven inadunates *Apographiocrinus*, *Coenocystis*, *Delocrinus*, *Graphiocrinus*, *Litocrinus*, *Neozeacrinus* and *Stuartwellercrinus*; and the flexible *Cibolocrinus*. It is possible that the camerate *Neoplatycrinus* also belongs to this small group as the columnals referred to as *Platyplateium*, are known in both realms, but typically found without the calyx.

Basleo genera extending into older strata with known representatives are: (1) *Calycocrinus*, *Synbathocrinus* and *Litocrinus*, from the Upper Carboniferous; (2) *Actinocrinites*, *Pleurocrinus*, *Platycrinites*, *Synbathocrinus*, *Litocrinus* and *Cydonocrinus* into the Early Carboniferous; and (3) *Synbathocrinus* into the Devonian. At the generic level these taxa are of little use for dating the age of the Basleo faunas. However, species of *Synbathocrinus* and *Cydonocrinus* known from both the Basleo beds and the Callytharra Formation (late Sakmarian–early Artinskian) suggest a closely coeval age for these faunas. Thus, comparison of the Basleo crinoid faunas with known faunas within the Tethys and Laurentian realms suggests that some of the Basleo faunas are of Artinskian age.

Geographic distribution and age of Permian blastoids were discussed by Breimer & Macurda (1972) and Waters (1990). Waters (1990: 339) stated 'The typical blastoid genus is monospecific, relatively short lived (range limited to some part of a single stage), relatively rare in terms of abundance, and geographically restricted to one depositional basin. Many are predominantly known from a single locality.' Thus, they should be of excellent correlation value on a regional basis.

Breimer & Macurda (1972) recognised three faunas in Timor, two Early Permian faunas (a Sakmarian fauna from Somohole and an Artinskian fauna from Tae Wei) and one early Late Permian, Wordian, fauna (Basleo). However, on the stratigraphic distribution chart (Breimer & Macurda 1972: fig. 100) they show the Basleo fauna as late Guadalupian which would be Capitanian instead of Wordian in the North American Permian stage terminology. Waters (1990) placed the Basleo fauna in the Kazanian without giving reasons but noted that the stratigraphic relations were poorly known.

Australian and Russian Permian blastoids are all considered late Sakmarian and early Artinskian (Breimer & Macurda 1972). Except for *Austroblastus* in eastern Australia and *Tympanoblastus* in Russia, all genera known from these two areas are common to the Basleo Beds, suggesting a similar age. The occurrence of *Neoschisma verrucosum*, *N. extensum*, *Notoblastus stellaris*, *Rhopaloblastus crepidus*, *Thaumatoblastus longiramous* and *T.* spp. from Artinskian deposits of the Callytharra Limestone, Bulgadoo Shale, or Noonkanbah Formation of Western Australia and the Basleo beds suggests an Artinskian age for the Basleo deposits and supports the modern concepts of Timor being a part of the Australian block in Permian time.

The unreported occurrence of *Deltoblastus* and *Timoroblastus coronatus* from Artinskian strata in Oman provides additional support for an Artinskian age of the Basleo faunas. Oman would have been within the southern part of the Tethys, to the west of Timor and Western Australia during Permian time.

Angioblastus in Early Permian deposits from Bolivia, Australia, Russia and Timor, could support an Artinskian age for the Basleo fauna. *Angioblastus* is a longer ranging genus, first occurring in the Middle Pennsylvanian of North America. However, the widespread Permian occurrence of this genus, known only in the Early Permian outside of Timor, suggests a probable correlation.

Breimer & Macurda (1972) and Macurda (1983) reported a specimen of *Pterotoblastus gracilis* from Ko Muk, Thailand. This specimen is from a locality of the Rat Buri Limestone which has yielded brachiopods (Grant 1976) and crinoids (Webster & Jell 1993) considered to be Artinskian. The occurrence of *P. gracilis* at Ko Muk and Basleo could support a coeval age for the two localities.

Amarassi

As noted above the stratigraphic section of Amarassi has seven stratigraphic units, four of which are crinoidal (Burck 1923). Wanner (1924a, 1924b) reported 24 crinoid or blastoid localities in the Amarassi District (Appendix, locs 16–39). Except for the main locality at Koewafeoe no more than four species are reported from any of the other 23 localities. Only six of the 23 localities contained four species not known in the Basleo faunas, this includes *Palaeoholopus* (Appendix, loc. 20). The detailed structure and stratigraphy of these important localities are unknown and it is uncertain whether these localities are equivalent to the Amarassi or Basleo faunas. Many of the localities yielded only *Deltoblastus* and probably need systematic collecting as noted by Wanner (1926).

Five of the crinoid species and one subspecies as well as one of the blastoid species found at Koewafeoe are not known at Basleo, whereas four species and two subspecies of crinoid and two species and one subspecies of blastoid are common to both localities. All of the genera are recognised in the general Basleo faunas. *Calycocrinus* is also common to Bitauni, Tae Wei and Basleo. *Cadocrinus* is also known from Timan and *Bolbocrinus* and *Calycocrinus* occur at Krasnoufimsk. *Embryocrinus* is present at Djebel Tebaga and has species restricted to Amarassi. *Cibolocrinus* is one of the most widespread forms known from Amarassi as it is cosmopolitan and occurs in most Laurentian and Tethys faunas. However, I question the generic assignment of all species of *Cibolocrinus* from Timor as most may be poteriocrinitids, not flexibles.

The Amarasssi ammonoids have long been considered the youngest from Timor (Haniel 1915; Glenister & Furnish 1988). They were dated as 'Amarassian' by Glenister & Furnish (1987) but should be referred to as Wuchiapingian. Glenister (1981) noted the problems of correlating Dzhulfian faunas because of their isolated occurrences and general lack of fossil bearing strata of post Guadalupian time.

There is probably more than one echinoderm fauna at Amarassi because it is likely that articulated echinoderms occur below and above the ammonoid bed in the stratigraphic section (see above). A few unidentified compressed crinoid cups were reported from the third limestone above the ammonoids by Burck (1923). However, a check of the Wanner publications describing and illustrating the species endemic to Amarassi do not indicate any compressed specimens. The species restricted to Koewafeoe could be geographic variants or younger forms from strata above the ammonoids. Crinoids below the ammonoids are possibly of Artinskian to Roadian age, in part equivalent to or slightly younger than the youngest Basleo fauna, and those above the ammonoids are possibly still Wuchiapingian. These are the youngest Permian crinoids known from cups.

Ajer Mati near Koepang

The Ajer Mati fauna (Appendix, loc. 15) contains six species of crinoids and one blastoid. All crinoids except *Calycocrinus kupangensis* are known in the Basleo fauna. Only two of the genera, *Calycocrinus* and *Deltoblastus*, are known from the Amarassi fauna. Haniel (1915) noted that the ammonoids from Ajer Mati occur in nodules within the crinoidal limestone and that they are correlative with the Amarassi ammonoid fauna. A Wuchiapingian age is assigned to the fauna.

RANGE CORRECTIONS

In the crinoid volumes of the *Treatise of Invertebrate Paleontology* (Moore & Teichert 1978) generic and suprageneric ranges are based on literature up to 1977. Editorial policy established the practise of range extension to the beginning and end of series for uniformity and simplicity. The Permian was divided into Lower and Upper Series.

The extension of the ranges of crinoid genera to the end of the Permian as generalised in the Treatise (Moore & Teichert 1978) is misleading in some respects. The youngest known Permian crinoids are the Amarassi fauna (Wanner 1924) and the recently described Cherrabun fauna of Western Australia (Webster & Jell 1992).

Misconceptions of the Timor faunas led to omission of the Early Permian range of some genera (i.e. *Eutelecrinus*, *Neoplatycrinus*, among others). Giving the range of 'Permian' for blastoid genera reported from Timor or elsewhere (Moore 1967) is a misleading extension at both ends of the known range. If genera of other phyla have been treated as those of the echinoderms then all the generic range information of Upper Permian needs considerable correction.

The utilisation of these misleading ranges for other purposes may lead to gross misconceptions. An example is the general acceptance of the terminal Permian extinction event (Maxwell 1989). The Treatise ranges for the crinoids mislead the reader into believing that most Permian crinoids reported from any part of the Upper Permian became extinct at the end of the Permian. These misleading ranges could then be used in compilations of generic ranges such as Sepkoski (1988, 1989) and used in calculations for periodicity of extinction events (Raup 1991), etc.

When the extinction of most of the genera of the Timor crinoids occurred is uncertain, but could have been about the end of the Artinskian or Wordian with few genera continuing into the Wuchiapingian. Glenister (1981) noted the extinction of many goniatites and fusulinids at the top of the Guadalupian which could have included the crinoids and blastoids. This may be the major extinction event of most Paleozoic faunas rather than the Permian–Triassic boundary.

CONCLUSIONS

The lack of a stratigraphic section at some of the reported fossil localities of Timor has been known, but not commonly acknowledged, for many years. Where stratigraphic sections are known from Timor it has been shown that the occurrence of the ammonoids and other invertebrates are commonly in different strata. Therefore, the ages of localities based only on ammonoids cannot be applied to all other invertebrates from the same locality. An Artinskian age is recognised for the Bitauni echinoderm fauna, based on the co-occurring condonts.

Considerable biostratigraphic data suggest an Artinskian age for a significant part of the Basleo echinoderm faunas. Ignoring the long-ranging genera that tend to be cosmopolitan and range from the Carboniferous, most genera reported from Timor are known from only one horizon. A few, i.e. *Deltoblastus*, *Calycocrinus* and *Eutelecrinus*, ranged throughout the Permian of Timor. Several genera occur in two or three major localities, a few are numerically abundant, i.e. *Timorocidaris*, *Cadocrinus*, *Timorechinus* and *Deltoblastus*, among others.

Crinoid and blastoid species common to Western Australia and the Basleo area are of the same or nearly equivalent age. That age is late Sakmarian to early Artinskian, based on the ammonoids that occur in the basal part of the Callytharra Formation and higher in the stratigraphic section above the Callytharra Formation. This is supported by *Timoroblastus coronatus* and *Deltoblastus* in the Basleo deposits and Artinskian deposits of Oman and *Pterotoblastus gracilis* in the Rat Buri Limestone of Thailand and the Basleo beds. It should be noted that none of these mutually common species are present in the known older or younger deposits of Timor or elsewhere.

Additional support for the Artinskian age of much of the Basleo faunas is the mutual occurrence of genera in the recognised Artinskian deposits of eastern and Western Australia, and Timan and Krasnoufimsk, Russia. The smaller number of mutual generic occurrences in the Basleo Beds and middle Wolfcampian faunas of southern Nevada and Texas in North America as well as the Copacabana Formation of Bolivia support an Artinskian age for some of the Basleo faunas. The few genera common to the Basleo beds and deposits of known Wordian age (Djebel Tebaga, Tunisia; Sosio, Sicily; and Berry Formation, eastern Australia) suggest part of the Basleo faunas are of post Artinskian age.

The age of genera reported only from the Basleo beds and unknown in other Permian deposits of the Tethys or elsewhere is uncertain. Because the Basleo collections are from soil horizons and mixing occurred it is possible that many specimens are of the same age as the mutually occurring species and genera, while other specimens are younger. Only proper collecting and establishment of a stratigraphic section for the Basleo and Amarassi localities will provide the answer to this.

Some parts of the Amarassi fauna may be of equivalent age to the Basleo beds and older than the Amarassi ammonoid fauna. None of the Amarassi crinoid genera are known to occur in or below the ammonoid bed except *Neocamptocrinus*, which Webster & Jell (1992) reported from the Cherrabun Member, Hardman Formation, Western Australia, occurring with *Cyclolobus persulcatus*. If any of the Amarassi crinoids and blastoids occur with the ammonoid fauna then they are of equivalent age to the Cherrabun fauna. If they occur above the ammonoids then they are the youngest known Permian crinoids, based on cups and crowns.

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APPENDIX

Section 1. List of Timor echinoderm localities. Localities and faunal lists taken from literature. Different spellings for the same locality (e.g. Fatu = Fatoe) are from Dutch (u) and German (oe) literature. Species authored by Wanner (1910–1949), Marez-Oyens (1940), Beyrich (1862), Rothplex (1892) and Bather (1910). Lithologies are given when originally given for locality.

1. Basleo vicinity, boldface *species* known in other localities, in addition to Basleo area.

Camerates

Actinocrinites brevispinus
Actinocrinites brouweri
Actinocrinites carinatus
Actinocrinites dilatatus
Actinocrinites exornatus
Actinocrinites permicus
Actinocrinites spinactectus
Actinocrinites timoricus
Camptocrinus indoaustralicus
Eutelecrinus ***piriformis***
Eutelecrinus ***poculiformis***
Metaeutelecrinus fritillus
Neodichocrinus nanus
Neoplatycrinus dilatatus
Neoplatycrinus major
Paraeutelecrinus ***elongatus***
Paraeutelecrinus erectus
Paraeutelecrinus subwelteri
Paraeutelecrinus ***welteri***
Platycrinites typicus
Platycrinites ***wachsmuthi***
Platycrinites ***wachsmuthi*** *frequentior*
Platycrinites wrighti
Pleisocrinus piriformis
Pleurocrinus depressus
Pleurocrinus goldfussi
Pleurocrinus spectabilis
Stomiocrinus minimus
Stomiocrinus piriformis
Stomiocrinus subglobosus
Wannerocrinus glans

Inadunates

Abrachiocrinus conicus
Abrachiocrinus timoricus
Acariaiocrinus angulosus
Acariaiocrinus clavulus
Allosycocrinus? grandis
Allosycocrinus? medius
Allosycocrinus pusillus
Apographiocrinus quinquelobus
Apographiocrinus rugosus
Apographiocrinus verbecki pumilus
Asymmetrocrinus poteriocrinoides
Atremacrinus calyculus
Baslcocrinus conicus
Basleocrinus obliquus
Basleocrinus pocillum
Basleocrinus pusillus
Basleocrinus striategranulatus
Basleocrinus turbinatus
Benthocrinus cryptobasalis
Bolbocrinus curvatus
Bolbocrinus hieroglyphicus
Bolbocrinus hieroglyphicus exornatus
Bolbocrinus hieroglyphicus tenuisculptus
Bolbocrinus hieroglyphicus tuberculatus
Bolbocrinus irregularis
Bolbocrinus pusillus
Bolbocrinus turbinatus
Bolbocrinus waldthauseniae basleoensis
Cadocrinus ***variabilis***
Cadocrinus ***variabilis*** *canaliculatus*
Calceolispongia aculeatus
Calceolispongia elegans
Ceratocrinus exornatus
Ceratocrinus gracilis
Coenocystis angulosa
Coenocystis perforata
Contignatocrinus contignatus
Cranocrinus timoricus
Cydonocrinus turbinatus
Cydonocrinus turbinatus minor
Delocrinus crassus
Delocrinus? malaianus
Depaocrinus ottowi
Embryocrinus hanieli
Graphiocrinus amplior
Graphiocrinus beyrichi
Graphiocrinusdeclivis
Graphiocrinus? depressus
Graphiocrinus? cf. depressus
Graphiocrinus? cf. depressus labiosus
Graphiocrinus excavatissimus
Graphiocrinus? excavatissimus
Graphiocrinus? excavatissimus ornatus
Graphiocrinus ovoides
Graphiocrinus pumilus
Graphiocrinus punctatus
Graphiocrinus scrobiculatus

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Graphiocrinus subamplior
Graphiocrinus rotundatus
Graphiocrinus verbeeki
Graphiocrinus verbeeki vermistriatus
Hemistreptacron carinatum
Hemistreptacron carinatum ornatum
Hypcrinus schneideri
Indocrinus crassus
Indocrinus elegans
Indocrinus nodosus
Indocrinus turgidus
Isocatillocrinus indicus
Lopadiocrinus angustecavatus
Lopadiocrinus brouweri
Lopadiocrinus brouweri vermistriatus
Lopadiocrinus granulatus
Lopadiocrinus granulatus labiosus
Lopadiocrinus tuberculatus
Malaiocrinus crassitesta
Malaiocrinus pusillus
Malaiocrinus sundaicus
Metallagecrinus acutus
Metallagecrinus dux
Metallagecrinus excavatus
Metallagecrinus indoaustralicus
Metallagecrinus inflatus
Metallagecrinus ornatus
Metallagecrinus procerus
Metallagecrinus quinquebrachiatus
Metallagecrinus quinquelobus
Metasycocrinus piriformis
Mollocrinus ornatissimus
Mollocrinus paucituberculatus
Mollocrinus poculum
Monobrachiocrinus ficiformis
Monobrachiocrinus ficiformis carinatus
Monobrachiocrinus ficiformis elongatus
Monobrachiocrinus ficiformis granulatus
Neocatillocrinus incisus
Neozeacrinus peramplus
Nereocrinus antiquus
Nereocrinus granulatus
Notiocrinus timoricus
Oklahomacrinus expansus
Parabursacrinus compressus
Parabursacrinus conus
Parabursacrinus magnificus
Parabursacrinus magnificus granulatus
Parabursacrinus procerus
Parabursacrinus pyramidatus
Parabursacrinus pyramidatus granulatus
Paracatillocrinus granulatus
Paradoxocrinus patella
Paragraphiocrinus exornatus
Paraplasocrinus transitorius
Parastachyocrinus granulatus
Parastachyocrinus inflatus
Parastachyocrinus malaianus
Parastachyocrinus malaianus ornatus
Parastachyocrinus obliquus
Parindocrinus oyensi
Permiocrinus immaturus
Pilidiocrinus permicus
Poteriocrinites malaianus
Prochoidocrinus nodosus
Prolobocrinus gracilis
Prolobocrinus permicus
Prolobocrinus striatus
Pumilindocrinus angulosus
Pumilindocrinus pumilus
Rimosindocrinus brevijugatus
Rimosindocrinus pachycephalus
Rimosindocrinus rimosus
Roemerocrinus gracilis
Roemerocrinus gracilis granulatus
Roemerocrinus scrobiculatus
Roemerocrinus turbinatus
Spaniocrinus validus
Spheniscocrinus spinosus
Stachyocrinus zea
Strongylocrinus molengraffi
Stuartwellercrinus jonkeri
Stuartwellercrinus minimus
Stuartwellercrinus propinquus
Stuartwellercrinus pusillus
Sundacrinus elongatus
Sundacrinus granulatus
Sundacrinus triangulus
Sundacrinus vastus
Synbathocrinus campanulatus
Synbathocrinus campanulatus elongatus
Synbathocrinus campanulatus inflatus
Synbathocrinus constrictus
Synbathocrinus constrictus sinuosus
Synyphocrinus indicus
Synyphocrinus trautscholdi
Synyphocrinus weidneri
Tapinocrinus timoricus
Tapinocrinus timoricus spinosus
Tenagocrinus sulcatus
Teratocrinus spathulites
Teratocrinus triangulatus
Thetidicrinus piriformis
Timorechinus decurtatus
Timorechinus lacertosus
Timorechinus mirabilis

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Timorechinus mirabilis vermistriatus
Timorechinus multicostatus
Timorechinus ***pentagonalis***
Timorechinus ***pentagonalis*** *nodosus*
Timorechinus proboscideus
Timorechinus spinosus
Timorechinus spinosus incisus
Timorocidaris baculiformis
Timorocidaris clavaeformis
Timorocidaris fusiformis
Timorocidaris sphaeracantha
Trimerocrinus minimus
Trimerocrinus pumilus
Trimerocrinus pumilus pentagonus
Ulocrinus conoideus = unnam. n. gen. 2
Ulocrinus ***indicus*** = unnam. n. gen. 2
Wrightocrinus jakovlevi
Xenocatillocrinus wrighti

Flexibles

Ancistrocrinus depressus
Ancistrocrinus vermistriatus
Brachypus, see Permobrachypus
Calycocrinus curvatus
Calycocrinus curvatus conicus
Calycocrinus curvatus coronatus
Calycocrinus curvatus depressus
Calycocrinus curvatus elongatus
Calycocrinus curvatus informis
Calycocrinus curvatus labrosus
Calycocrinus curvatus subcoronatus
Calycocrinus curvatus subturbinatus
Calycocrinus curvatus turbinatus
Calycocrinus erectus
Calycocrinus ***granulatus***
Calycocrinus ***granulatus*** *altior*
Calycocrinus labiatus
Calycocrinus major
Calycocrinus malaianus
Calycocrinus millericrinoides
Calycocrinus nuciformis
Calycocrinus patella
Calycocrinus perplexus
Calycocrinus piriformis
Calycocrinus poculum
Calycocrinus similis
Calycocrinus spinosus
Calycocrinus tuberculatus
Calycocrinus venemai
Calycocrinus venemai angulatus
Calycocrinus venemai planus
Cibolocrinus spinosus
Cibolocrinus timorensis
Loxocrinus dilatatus
Loxocrinus globulus
Permobrachypus adhaerens
Petrocrinus beyrichi
Petrocrinus boschi
Plagiocrinus infratextus
Plagiocrinus jaekeli
Plagiocrinus torynocrinoides
Proapsidocrinus cuspidatus
Proapsidocrinus permicus
Prophyllocrinus ***dentatus***
Rumphiocrinus singularis
Syntomocrinus ***sundaicus***

Basleo, indeterminate order

Jonkerocrinus spinosus
Peripterocrinus gracilis
Teratocrinus spathulifer
Teratocrinus? triangulatus

Blastoids

Anthoblastus stelliformis
Nannoblastus pyramidatus
Pterotoblastus brevialatus
Pterotoblastus decemcostis
Pterotoblastus gracilis
Angioblastus variabilis
Neoschisma timorense
Neoschisma ***verrucosum***
Dipteroblastus permicus
Timoroblastus ***coronatus***
Notoblatus oyensi
Thaumatoblastus ***longiramus***
Ceratoblastus nanus
Indoblastus granulatus
Indoblastus ***weberi***
Rhopaloblastus timoricus
Deltoblastus batheri
Deltoblastus crassus
Deltoblastus delta
Deltoblastus molengraaffi
Deltoblastus ***permicus***
Deltoblastus pseudodelta
Deltoblastus timorensis
Deltoblastus ***timorensis globosus***
Deltoblastus ***verbeeki***
Deltoblastus ***verbeeki*** *elongatus*
Orbitremites malaianus

Basleo vicinity localities 2–14 from Molengraaff (1915) as indicated, all others Wanner (1924a crinoids, 1924b blastoids). Bold face ***species*** do not occur in general Basleo fauna. Lithologies are given when originally given for locality.

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2. Between Niki Niki and Noil Fatoe (= N. Fatu), red-brown or yellow marl.
   Platyerinites wachsmuthi
   Pleurocrinus pusillus
   Pleurocrinus globosus
   Neoplatyerinus dilatatus
   Neoplatycrinus major
   Loxoerinus globulus
   Syntomocrinus sundaicus
   Prophylloerinus dentatus
   Proaspidocrinus cuspidatus
   cf. *Bolbocrinus* spec. nov. 2
   Thetidierinus piriformis
   Hyposerinus selmeideri
   Monobraehiocrinus fieiformis
   Embryoerinus hanieli
   Graphioerinus exornatus
   Graphiocrinus verbeeki
   Parastachyoerinus malaianus
   Cadoerinus variabilis
   Paraplasocrinus transitorius
   Timorechinus spinosus pentagonalis
   Strongylocrinus molengraaffi
   Stachyocrinus zea
   Timoroblastus eoronatus
   Indoblastus granulatus
   Deltoblastus verbeeki
   Deltoblastus batheri
   Deltoblastus permicus
3. Noil Fatoe (= N. Fatu), red-brown or yellow marl.
   Platyerinites wachsmuthi
   Neoplatycrinus dilatatus
   Neoplatycrinus major
   Euteleerinus piriformis
   Eutelecrinus mangostanus
   Prophylloerinus dentatus
   Proapsidoeuspidatus
   Hypocrinus selmeideri
   Monobrachiocrinus fieiformis
   Embryoerinus hanieli
   Synbathoerinus eampanulatus inflatus
   Poterioerinites malaianus
   Cadoerinus variabilis
   Timoreehinus alatus
   Timorechinus spinosus
   Thaumatoblastus longiramus
   Timoroblastus eoronatus
   Deltoblastus verbeeki
   Deltoblastus batheri
   Deltoblastus permieus ellipticus
4. Right bank and right valley wall of Noil Fatoe (= N. Fatu). Wanner No. 635 and Molengraaff, red-brown or yellow marl.
   Syntomocrinus sundaicus
   Graphioerinus timoricus
   Cadocrinus variabilis
   Lopadioerinus granulatus
   Timoroblastus coronatus
   Deltoblastus permieus elliptieus
5. Opposite Fatoe Tonini, red-brown or yellow marl.
   Neoplatyerinus dilatatus
   Neoplatycrinus transitorius
   Syntomocrinus sundaicus
   Calycocrinus curvatus typus
   Prophylloerinus dentatus
   Graphioerinus exornatus
   Graphiocrinus depressus
6. Between Noil Fatoe and Noil Tonini, red-brown or yellow marl.
   Platycriniites waehsmuthi
7. Profile Noil Tonini (Toeninoe), greenish tuff.
   Platycrinites waehsmuthi
   Neoplatycrinus dilatatus
   Loxocrinus globulus
   Bolboerinus rex
   Monobrachiocrinus fieiformis
   Cadoerinus variabilis
   Timoreehinus multicostatus
   Timorechinus spinosus
   Timoroeidaris clavaeformis
   Synbathoerinus eampanulatus inflatus
   Pterotoblastus gracilis
   Nannoblastus pyramidatus
   Timoroblastus coronatus
   Deltoblastus permieus elliptieus
8. Noil Tonini No. 567, ser. III. Molengraaff, greenish tuff.
   Platycrinites wachsmuthi
   Neoplatycrinus dilatatus
   Neoplatycrinus major
   Monobrachiocrinus fieiformis
   Cadocrinus variabilis
   Deltoblastus jonkeri
   Deltoblastus verbeeki
   Deltoblastus batheri
   Deltoblastus permicus
   Deltoblastus permieus elliptieus
9. Left bank of Noil Boewan (= N. Buwan), boundary Landschaften, Amanoeban and Amanatoen, greenish tuff.
   Neoplatycrinus major
   Deltoblastus permieus elliptieus

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10. Path from Noil Fatoe toward Senoe (= Senu), 1/2 hour toward locality No. 162. No. 182, ser. III Molengraaff.
    Deltoblastus ***jonkeri***
    Deltoblastus bathеri
11. Path from Niki Niki toward Senoe, in proximity of Noil Tonini. Molengraaff.
    Deltoblastus permicus ***ellipticus***
12. Right bank Noil Fatoe in direction toward Dorf Talas. No. 163, ser. III Molengraaff.
    Deltoblastus batheri
13. Noil Boewan (= Boenoe, Bunu), dense at crossing of path from Niki Niki toward Toi. No. 565 ser. III Molengraaff.
    Deltoblastus permicus ***ellipticus***
14. Between Bele and Niki Niki, 3/4 hour from Bele. No. 180, ser. III. Molengraaff.
    Deltoblastus batheri
    Deltoblastus permicus ***ellipticus***

Localities 15–57 from Molengraaff (1915), Jonker expedition of 1916, and Weber expedition of 1911, as indicated, all others from Wanner (1910–1949). **Taxa** in boldface do not occur in Basleo general fauna.

15. Ajer Mati near Koepang (= Kupang).
    Calycocrinus ***kupangensis***
    Calycocrinus granulatus
    Basleocrinus striategranulatus
    Thetidicrinus piriformis
    Metasycocrinus piriformis
    Hypocrinus schneideri
    Deltoblastus permicus
16. Koeafeoe (Koewafeoe), *c*. 4 km from Baung toward Oikabitti. Landschaft Amarassi.
    Eutelecrinus poculiformis
    Calycocrinus curvatus turbinatus
    Calycocrinus curvatus ***amarassicus***
    Prophyllocrinus dentatus
    Bolbocrinus ***waldthauseniae***
    Embryocrinus ***sulcatus***
    Cadocrinus variabilis
    Cadocrinus ***amarassicus***
    Paraplasocrinus transitorius
    Timoroechinus alatus ***major***
    Timoroechinus spinosus pentagonalis
    Deltoblastus timorensis
    Deltoblastus timorensis ***globosa***
    Deltoblastus delta
    Deltoblastus delta ***elongata***
17. Koeka near Baung, Landschaft Amarassi.
    Petrocrinus ***kukaensis***
    Monobrachiocrinus ficiformis
    Embryocrinus hanieli
18. Saokefi near Baung, Landschaft Amarassi.
    Calycocrinus amarassicus
    Ceriocrinus beyrichi
19. Si (Siih) near Noestoi (Nustoi) near Baung, Landschaft Amarassi.
    Ceriocrinus beyrichi nustoiensis
    Deltoblastus delta
20. Iknin near Baung, Landschaft Amarassi.
    Palaeoholopus ***pretiosus***
21. Matanekore near Baung, Landschaft Amarassi.
    Timoroechinus ***spinosus amarassicus***
    Deltoblastus timorensis
    Deltoblastus delta
    Deltoblastus permicus
22. Soefa near Baung, Landschaft Amarassi.
    Poteriocrinidae gen. ind. et spec. nov. 1
23. Doeasnain near Baung, Landschaft Amarassi.
    Syntomocrinus sundaicus
24. Naboe near Fatu Tassoe near Baung, Landschaft Amarassi.
    Syntomocrinus sundaicus
25. Nekemareno near Soba near Baung, Landschaft Amarassi.
    Poteriocrinitidae **gen. et spec. indet. 11**
26. Mot near Soba near Baung, Landschaft Amarassi.
    Timorechinus spinosus
    Deltoblastus delta
27. Doeasnain (= Roasnain) near Koeafeoe, Landschaft Amarassi.
    Deltoblastus delta
    Deltoblastus delta elongata
28. Oineno (= Oenona), Landschaft Amarassi.
    Deltoblastus timorensis
29. Oenairoekoe (= Oe naroekoe), Landschaft Amarassi.
    Deltoblastus timorensis
    Deltoblastus delta
30. Matanibaki, Landschaft Amarassi.
    Deltoblastus timorensis
31. Fatu Dewi, Landschaft Amarassi.
    Deltoblastus timorensis
    Deltoblastus delta
32. Hasrani, Landschaft Amarassi.
    Deltoblastus delta

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33. Nonotahai, Landschaft Amarassi.
    Deltoblastus delta

34. Neofmoetih, Landschaft Amarassi.
    Deltoblastus delta

35. Nioebana near Nobrana, Landschaft Amarassi.
    Deltooblastus delta

36. Toeporo (perhaps identical with Toeboeroporo of 2nd Netherlands Timor expedition), Landschaft Amarassi.
    Deltoblastus delta

37. Safoen near Soba, Landschaft Amarassi.
    Deltoblastus timorensis
    Deltoblastus delta

38. Noenpaung near Soba, Landschaft Amarassi.
    Deltoblastus delta

39. Bisano south of Baung, Landschaft Amarassi.
    Deltoblastus timorensis
    Deltoblastus delta

40. Path from Fatu Metan toward Kapan, *c.* 300 m from Fatu Metan, Landschaft Mollo (No. 217, ser. III, Molengraaff).
    Hypocrinus schneideri
    Deltoblastus permicus

41. Dorf Sebot (= Sebat, Sabau) in the spring region of the Noil Sebot on way from Kapan toward Bonleo, Landschaft Mollo (Molengraaff & Jonker).
    Eutelecrinus piriformis
    Eutelecrinus poculiformis
    Paraeutelecrinus elongatus
    Paraeutelecrinus welteri
    Hypocrinus schneideri
    Monobrachiocrinus ficiformis elongatus
    Embryocrinus hanieli
    Mollocrinus poculum
    Graphiocrinus verbeeki
    Graphiocrinus verbeeki vermistriatus
    Synbathocrinus campanulatus elongatus
    Timoroblastus coronaus
    Deltoblastus molengraaffi sebotensis
    Deltoblastus permicus elliptica

42. 1 km south of Kapan, Landschaft Mollo (Molengraaff).
    Neoschisma verrucosum

43. Noil Niti, *c.* 150 m downstream from the path crossroads Lelogama-Biwak Tanini, Landschaft Kaoniki.
    Platycrinites wachsmuthi
    Thetidicrinus piriformis
    Deltoblastus permicus

44. Noil Ekad not far from Noil Toko, Landschaft Miomaffo (Jonker).
    Calceolispongia cornutus
    Notiocrinus ekadensis
    Deltoblastus magnificus

45. Noil Nalien near Dorf Tamien, Boundary Landschaft Miomaffo and Portuguese district Oikusi (Molengraaff).
    Actinocrinidae gen. et spec. ind. 2
    Calceolispongia cornutus

46. About half way from Adjau toward Maubesi, Landschaft Insana (No. 155, ser. III, Molengraaff).
    Calycocrinus crassus

47. Bitauni, Landschaft Insana (Molengraaff & Wanner).
    Batocrininae, gen. nov. et spec. nov.
    Platycrinites sp.
    Metasycocrinus piriformis
    Paradoxocrinus patella

48. North of bivouc Bitauna, Landschaft Insana (Molengraaff), red marl.
    Calycocrinus granulatus

49. Somohole, *c.* 4.5 km south of Soefa, Landschaft Beboki (Molengraff & Jonker), reddish-brown volcanic tuff.
    Neoplatycrinus somoholensis
    Eutelecrinus subglobosus
    Coenocystis somoholensis
    Lageniocrinus seminulum timorensis
    Mollocrinus poculum
    Sphaeroschisma somoholense
    Anthoblastus brouweri
    Nannoblastus cuspidatus
    Calycoblastus tricavatus
    Deltoblastus somoholensis

50. Upper half bivouac Soefa, Landschaft Beboki. No. 552, ser. IV Molengraaff, grey marl.
    Embryocrinus hanieli

51. Dorf Apna, Landschaft Beboki (southwest of Soefa near Baung).
    Platycrinites wachsmuthi apnaensis
    Paracatillocrinus spinosus

52. Too, northeast of Soefa, half way between Soefa and Oeroeki, Landschaft Beboki (Jonker).
    Calceolispongia mammeatus
    Calceolispongia cornutus

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53. Nefotassi near Soefa, Landschaft Beboki (Jonker) [Bitauni fauna].
    Monobrachiocrinus granulatus
    Parabursacrinus nefotassiensis
    Calceolispongia mammeatus
    Timorechinus nefotassiensis
    Timorechinus maximus
    crinoidea gen. nov. et spec. nov. indet. 1
    crinoidea gen. et. spec. indet. 3

54. Mandeo, Landschaft Mandeo (No. 188, ser. III, Molengraaff).
    Calycocrinus crassus

55. Near Aitali (Aitoli) on up valley flow south of Atamboea, Boundary of Landschaften Lidak and Fialarang (Jonker).
    Criniodea gen nov. and
    spec. nov. ind. 6

56. Hatu Dame, on north slope of Ramelau Mountains, Portuguese Timor, Landschaft Atsabe (Weber).
    Platycrinites **cf.** *rugosus*
    Indoblastus weberi

57. Batu Berketak, Island Rotti, volcanic ejecta.
    Cadocrinus variabilis

Localities 58–91 are from the Basleo region and listed in Wanner (1937, 1940, 1949) and Bassler & Moodey (1943) with species added from Wanner publications to Bassler & Moodey localities. Localities of Bassler & Mooday that are known to be the same as previously listed Wanner localities are not repeated in the following lists. Species from the Walsh Collection (WC) and Trechmann bequest (TB), British Museum of Natural History, were identified by me and added to locality lists as indicated.

58. Afukele (Wanner 1937)
    Neoplatycrinus dilatatus
    Paraeutelecrinus welteri
    Pleurocrinus spectabilis

59. Falas, *c.* 900 m from Basleo along path toward Noil Fatu (Bassler & Moodey 1943; Wanner 1940).
    Graphiocrinus pumilus
    Cadocrinus cariabilis
    Parastachyocrinus malaianus
    Platycrinites wachsmuthi frequentior
    Neoplatycrinus dilatatus
    Timorocidaris clavaeformis

60. Faoet Ao (all Walsh Collection).
    Eutelecrinus poculiformis
    Neoplatycrinus dilatatus
    Lopadiocrinus granulatus
    Timorechinus miribilis
    Timorocidaris sphaeracantha
    Timoroblastus coronuaus
    Deltoblastus batheri
    Deltoblastus molengraffi
    Deltoblastus permicus
    Deltoblastus permicus ellipticus
    Neoschisma verrucosum
    Neoschisma delta

61. Fatu Aoeh (Wanner 1937, 1940).
    Neoplatycrinus dilatatus
    Platycrinites wachsmuthi
    Pleurocrinus spectabilis
    Timorocidaris sphaeracantha

62. Fatu Inu (= F. Jnu) (Wanner 1937, 1940).
    Neoplatycrinus dilatatus
    Timorocidaris sphaerocantha

63. Fatu Nek-Lape (Wanner 1937, 1940).
    Platycrinites wachsmuthi
    Timorocidaris sphaeracantha

64. Fatu Noil Tobe (Wanner 1937, 1940).
    Neoplatycrinus dilatatus
    Platycrinites wachsmuthi frequentori
    Pleurocrinus spectabilis
    Embryocrinus hanelei WC
    Lopadiocrinus granulatus WC
    Timorocidaris sphaeracantha

65. Fatu Somfaf (Wanner 1937).
    Neoplatycrinus dilatatus
    Platycrinites wachsmuthi
    Pleurocrinus spectabilis

66. Kelniti (Wanner 1937).
    Paraeutelecrinus welteri

67. Kiumoko (Kioemoko) (Basleo region) (Wanner 1937; Marez-Oyens 1940; Bassler & Moodey 1943).
    Eutelcrinus poculiformis WC
    Platycrinites wachsmuthi
    Neoplatycrinus dilatatus
    Paracatillocrinus granulatus WC
    Embryocrinus haneli WC
    Hypocrinus schneideri WC
    Bolbocrinus waldthausaniae WC
    Monobrachiocrinus ficiformis WC
    Indocrinus elegans WC
    Cadocrinus variabilis WC

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Graphiocrinus pumilus
Delocrinus rugosus WC
Delocrinus sp. WC
Paraplasocrrinus transitorius WC
Parastachyocrinus malaianus WC
Paragraphiocrinus exornatus WC
Lopadiocrinus granulatus
Loxocrinus booni
Loxocrinus globulus WC
Stuartwellercrinus propinquus
Timorechinus miribilis WC
Timorechinus miribilis multicostatus WC
Timorechinus spinosus WC
Timorocidaris sphaeracantha WC
Syntomocrinus sundaicus WC
Calycocrinus granulata WC
Calycocrinus spinosus WC
Prophyllocrinus dentatus WC
Timoroblastus coronatus WC
Deltoblastus batheri WC
Deltoblastus delta WC
Deltoblastus molengraaffi WC
Deltoblastus onkeri WC
Deltoblastus permicusellipticus WC
Deltoblastus verbeeki WC

68. Mangan Tobe (Wanner 1937).
Neoplatycrinus dilatatus
Platycrinites wachsmuthi frequentori

69. Mau Leum (Wanner 1937, 1940).
Neoplatycrinus dilatatus
Timorocidaris sphaeracantha

70. Netu Bunie (Wanner 1940).
Timorocidaris sphaeracantha

71. Netu Kot (= Netoe Kot) (Wanner 1937).
Platycrinites wachsmuthi
Timorechinus miribilis WC

72. Nifoe Moeti (Wanner 1937).
Isocatillocrinus indicus

73. Nipol Sumpek (= Nipol Soempek) (Wanner 1937; Bassler & Moodey 1943).
Calceolispongia bifurcatus
Nereocrinus antiquus

74. Noil Buan (near mouth) (Basleo region).
Timorocidaris fungiformis

75. Noil Fatu (Wanner 1937).
Neoplatycrinus dilatatus
Platycrinites wachsmuthi

76. Noko (between Basleo and Noil Toke) (Wanner 1937, 1940; Marez-Oyens 1940; Bassler & Moodey 1943).
Dichostreblocrinus timorensis
Metaeutelecrinus fritillus
Acariaiocrinus angulosus
Basleocrinus striategranulatus
Bolbocrinus curvatus
Hemistreptacron carinatum ornatum
Mollocrinus poculum
Monobrachiocrinus waitze
Teratocrinus spathulifer
Timorocidaris clavaeformis
Timorocidaris fusiformis
Wrightocrinus jakovlevi

77. Oe Masih (= Oi Masik), Between Basleo and Nipol, along trail, *c.* 500 m above end of trail at Noil Bunu (Wanner 1940; Bassler & Moodey 1943).
Cadocrinus variabilis
Platycrinites wachsmuthi frequentori
Stuartwellercrinus propinquus
Timorocidaris clavaeformis

78. Oi Fapunu (= Oe Fapunu) (Wanner 1937).
Neoplatycrinus dilatatus

79. Oi Faoeh (= Oi Fauh, Oe Fauh), (Marez-Oyens 1940).
?Jonkerocrinus conicus
Platycrinites wachsmuthi
Pleurocrinus spectabilis
Tapinocrinus timoricus

80. Pantukak (*c.* 200 m toward Silu on footpath toward Noil Bunu, Basleo region), (Netoe Pantoekak = Netu Pantukak) (Neoet Pantoekak WC) (Bassler & Moodey 1943).
Eutelcrinus poculiformis WC
Platycrinites wachsmuthi
Neoplatycrinus dilatatus WC
Synbathocrinus constrictus WC
Embryocrinus hanelei WC
Hypocrinus schneideri TB
Bolbocrinus waldthausaniae WC
Thetidicrinus piriformis WC
Monobrachiocrinus ficiformis WC
Strongylocrinus molengraaffi WC
Basleocrinus conicus
Basleocrinus? sp. WC
Cadocrinus variabilis
Graphiocrinus excavatissimus
Graphiocrinus pumilus
Graphiocrinus verbeeki WC
Graphiocrinus? ovoides WC
Delocrinus? sp. WC
Paraplasiocrinus transitorius WC

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Paragraphiocrinus exornatus WC
Benthocrinus cryptobasalis
Lopadiocrinus granulatus
Parabursacrinus? gracilis
Tapinocrinus timoricus
Terataocrinus spathulifer
Timorocidaris sphaerocantha
Timorechinus miribilis WC
Timorechinus miribilis multicostatus WC
Timorechinus spinosus WC
'Cibolocrinus' spinosus WC
Loxocrinus globulus WC
Syntomocrinus sundaicus WC
Calycocrinus major WC
Prophyllocrinus dentatus WC
Timoroblastus coronutus WC
Thaumatoblastus oligiramus WC
Deltoblastus batheri WC
Deltoblastus delta WC
Deltoblastus molengraaffi WC
Deltoblastus jonkeri WC
Deltoblastus permicus ellipticus WC

81. Snob Nenoe (= S. Nenu).
Calycocrinus curvatus coronatus
Syntomocrinus sundaicus

82. Snofenio (all Walsh collection).
Platycrinites cf. *rugosus*
Platycrinites wachsmuthi
Synbathocrinus constrictus
Paradoxocrinus sp.
Paraplasiocrinus transitorius
Parastachyocrinus malaianus
Paragraphiocrinus exornatus
Timorechinus spinosus
Timorocidaris sphaeracantha
Timoroblastus coronutus

83. Soempek Safneo (= Sumpeh Safneo) (*c.* 500 m from Nipol, between Oi Sumpeh and Noil Suti, Basleo region) (Bassler & Moodey 1943).
Camptocrinus indoaustralicus WC
Eutelecrinus elongatus WC
Platycrinites cf. *rugosus* WC
Platycrinites wachsmuthi
Pleurocrinus spectabilis
Neoplatycrinus dilatatus
Hypocrinus schneideri WC
Thetidicrinus piriformis WC
Monobrachiocrinus ficiformis WC
Poteriocrinites malaianus WC
Indocrinus elegans WC
Basleocrinus striategranulatus
Cadocrinus variabilis
Graphiocrinus verbeeki WC
Lopadiocrinus granulatus WC
Neozeacrinus springeri
Neozeacrinus peramplus
Parastachyocrinus malaianus
Stuartwellercrinus propinquus
Timorechinus miribilis WC
Timorocidaris sphaeracantha WC
Calycocrinus curvatus labrosus
Calycocrinus granulatus WC
Cibolocrinus timorensis
Prophyllocrinus dentatus WC
Timoroblastus coronatus WC
Thaumatoblastus oligiramus WC
Deltoblastus batheri WC
Deltoblastus delta WC
Deltoblastus delta subglobosus WC
Deltoblastus permicus ellipticus WC
Deltoblastus pseudodelta WC
Deltoblastus verbeeki WC

84. Soka, along Noil Tobe, between Basleo and Noil Bunu (Bassler & Moodey 1943).
Timorocidaris clavaeformis

85. Susu Mepa (Wanner 1937).
Neoplatycrinus dilatatus
Platycrinites wachsmuthi frequentori

86. Toeboe Lopo (= Tubulopo, = Lopo) (Bassler & Moodey 1943).
Metallagecrinus quinquebrachiatus
Neocatillocrinus incisus
Trimerocrinus minimus
Wrightocrinus jakovlevi

87. Toenioen Eno (Tunium Eno; Tuniun) (Bassler & Moodey 1943).
Eutelecrinus poculiformis WC
Eutelecrinus inflatus WC
Platycrinites wachsmuthi
Pleurocrinus spectabilis
Neoplatycrinus dilatatus
Paracatillocrinus granulatus WC
Synbathocrinus constrictus WC
Embryocrinus hanelei WC
Hypocrinus schneideri WC
Bolbocrinus waldthausaniae WC
Bolbocrinus tuberculatus WC
Thetidicrinus piriformis WC
Monobrachiocrinus ficiformis WC
Strongylocrinus molegraaffi WC
Indocrinus crassus WC

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Indocrinus elegans WC
Sundacrinus triangulus WC
Basleocrinus cf. pucillus WC
Basleocrinus? sp. WC
Ulocrinus? conoideus WC
Cadocrinus variabilis
Calycocrinus curvatus subcoronatus
Graphiocrinus pumilus
Graphiocrinus ovoides WC
Graphiocrinus timoricus WC
Graphiocrinus verbeeki WC
Graphiocrinus depressus labiosus WC
Paragraphiocrinus exornatus WC
Lopadiocrinus granulatus
Neozeacrinus springeri
Stachyocrinus zea WC
Parastachyocrinus malaianus
Parastachyocrinus malaianus ornatus WC
Parabursacrinus magnificus WC
Parabursacrinus pyramidalis WC
Stuartwellercrinus propinquus
Teratocrinus? bulbosus
Timorechinus miribilis WC
Timorechinus spinosus WC
Timorechinus aff. *proboscideus* WC
Timorocidaris fusiformis
Timorocidaris sphaeracantha
'Cibolocrinus' transitorius WC
Loxocrinus globulus WC
Loxocrinus sp. WC
Syntomocrinus sundaicus WC
Calycocrinus granulata WC
Calycocrinus curvatus WC
Calycocrinus spinosus WC
Prophyllocrinus dentatus WC
Proapsidocrinus cuspidatus WC
Timoroblastus coronatus
Timoroblastus coronatus ingens
Timoroblastus sphaerocantha
Thaumatoblastus oligiramus WC
Deltoblastus batheri WC
Deltoblastus delta WC
Deltoblastus molengraaffi WC
Deltoblastus jonkeri WC
Deltoblastus permicus ellipticus WC
Deltoblastus verbeeki WC

88. Tae Wei (Marez-Oyens 1940; Bassler & Moodey 1943).
Parasycocrinus fastigatepileatus
Timorocidarus pistilliformis
Calycocrinus labiatus
Pterotoblastus ferrugineus
Timoroblastus weienensis

89. Toe Lina.
Paradoxocrinus patella

90. Koaneke (= Koanele), (Bassler & Moodey 1943), Distriet Miomaffo.
Deltoblastus magnificus

Regional locality unknown to date; Basleo Region? (Bassler & Moodey 1943).

91. Kiukilo.
Prolobocrinus striatus
Timorocidaris fusiformis

Section 2. Non-Timor localities referred to in Table 2. Data compiled from Bassler & Moodey (1943) and Webster (1973, 1977, 1986, 1988, 1993, unpubl.). Localities include nomenclatorial changes tabulated in the Webster references. For each locality taxa known from Timor are in bold face, i.e. ***Genus*** in Timor, ***species*** in Timor.

Callytharra Formation, late Sakmarian–early Artinskian, Western Australia (Teichert 1949; Webster 1987; Webster & Jell 1992).

Camerates
Coelocrinid? indet. cf. *Dorycrinus*
Actinocrinites cf. ***A. brouweri***
Neocamptocrinus sp.
Platycrinites wrighti
Neoplatycrinus callytharraensis
Platycrinites–Neoplatycrinites sp.
Indet. dichocrinid radial 1
Indet. dichocrinid radial 2
Indet. dichocrinid radial 3
Indet. camerate radial 1
Indet. camerate radial 2
Indet. camerate radial 3
Indet. camerate radial 4
Indet. camerate radial 5

Inadunates
Wrightocrinus wooramelensis
Litocrinus pansus
Litocrinus protuberans

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Notiocatillocrinus callytharraensis
Synbathocrinus constrictus
Synbathocrinus campanulatus
Barycrinus? indet
Lampadosocrinus variabilis
Cosmetocrinus? middalyaensis
Cydonocrinus cf. *C. turbinatus*
Tapinocrinus macurdai
Tapinocrinus ingrami
Tapinocrinus? sp.
Parabursacrinus magnificus
Parabursacrinus granulatus
Parabursacrinus nefotassiensis
Apographiocrinus pumilus
Minilyacrinus williamburyensis
Galateacrinus australis
Texacrinus goochensis
Timorechinid gen. indet. (set of arms)
Calceolispongia spinosa (basals)
Calceolispongia cf. *C. spinosa* (basal)
Calceolispongia digitata (basals)
Calceolispongiidae sp. indet.
Indet. inadunate radial 1
Indet. inadunate radial 2
Indet. inadunate radial 3
Indet. inadunate radial 4
Indet. inadunate radial 5
Indet. inadunate radial 6
Indet. inadunate radial 7
Indet. inadunate radial 8
Indet. inadunate radial 9
Indet. inadunate radial 10
Family and genus indet. (set of arms)
Baryschyr? carnarvonensis (cols)

Flexibles
Indet. flexible radial 1

Blastoids
Neoschisma australe
Neoschisma verrucosum
Neoschisma extensum
Notoblastus stellaris
Rhopaloblastus cuspidatus
Deltoid indet.

Krasnoufimsk, late Artinskian, southern Ural Mtns, Russia (Yakovlev & Ivanov 1956; Arendt 1968, 1978).

Camerates
Camptocrinus permiensis
Platycrinites permiensis
Stomiocrinus permiensis

Inadunates
Acariaiocrinus caryophylloides
Basleocrinus krasnooufimskensis
Delocrinus serratomarginatus
Graphiocrinus elenae
Epihalysiocrinus tuberculatus
Hemiindocrinus fredericksi
Hemimollocrinus uralensis
Hemistreptacron abrachiatus
Hypermorphocrinus magnospinosus
Kallimorphocrinus multibrachiatus
Kallimorphocrinus uralensis
Kallimorphocrinus uralensis nodocarinatus
Monobrachiocrinus oviformis
Nereocrinus jemeljantzevi
Proindocrinus piszowi
Strongylocrinus uralicus
Sundacrinus septentrionalis
Trimerocrinus platypleura
Ulocrinus uralensis

Flexibles
Bolbocrinus eudoxiae
Calycocrinus rossicus
Calycocrinus sp.
Cibolocrinus treuteri
Ammonicrinus? nordicus (col)

Blastoids
Angioblastus elongatus
Angioblastus wanneri

Wandagee Formation, late Artinskian, Western Australia (Teichert 1949; Webster 1990; Webster & Jell 1992).

Camerates
Neocamptocrinus sp.
Stomiocrinus ferruginus

Inadunates
Rhenocrinidae gen. et sp. nov.
Oeciducrinus australis
Tapinocrinus spinosus
Skaiocrinus granulosus
Eoindocrinus praecontignatus
Calceolispongia abundans
Calceolispongia acuminata
Calceolispongia elegantula
Calceolispongia hindei
Calceolispongia multiformis
Calceolispongia robusta
Calceolispongia rotundata
Calceolispongia rubra
Calceolispongia spectabilis

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Calceolispongia spp. ind. A through F
Jimbacrinus minilyaensis
Family and genus indet.

Crinoidal Zone, early Artinskian, Tasmania, Australia (Sieverts-Doreck 1942; Willink 1979b, 1980a, 1980b).

Camerates
Neocamptocrinus *banksi* (col)
Neocamptocrinus *bernacchiensis* (col)
Neocamptocrinus *doreckae* (col)
Neocamptocrinus *sievertsae* (col)
Neocamptocrinus *tasmaniensis* (col)
Neocamptocrinus sp. cf. *N.? tasmaniensis* (col)
Neocamptocrinus sp. indet.
Dichocrinus? darlingtonensis

Inadunates
Calceolispongia *diemenensis*
Calceolispongia *gerthi*
Jimbacrinus? noetlingi

Wandrawandian Siltstone, late Artinskian, New South Wales, Australia (Willink 1978, 1979b, 1980a, 1980b).

Camerates
Dichocrinus? australia
Neocamptocrinus? *gremialis*
Neocamptocrinus wardenensis

Inadunates
Notiocatillocrinus cephalonus
Notiocatillocrinus giganteus
Calceolispongia *nodosa*
Calceolispongia *teicherti*
Calceolispongia *ulladullensis*
Tribrachyocrinus corrugatus
Tribrachyocrinus etheridgei

Timan, Artinskian, Russia (Yakovlev 1941, 1948; Yakovlev, in Yakovlev & Ivanov 1956).

Camerates
Dichocrinus schmidtii
Platycrinites *schmidtii*
Platycrinites sp.

Inadunates
Cadocrinus *timanicus*
Graphiocrinus *timanicus*
Protencrinus lobatus
Stachyocrinus *timanicus*

Bird Spring Formation, middle Artinskian, southern Nevada, USA (Lane & Webster 1966; Webster & Lane 1967).

Camerates
Platycrinites sp.

Inadunates
Isoallagecrinus eaglei
Brabeocrinus cuneatus
Stellarocrinus comptus
Stellarocrinus? sp.
Celonocrinus expansus
Celonocrinus nodulus
Synyphocrinus *permicus*
Agnostocrinus typus
Elibatocrinus elongatus
Moscovicrinus bipinnatus
Moapacrinus rotudatus
Moapacrinus inonatus
Texacrinus distortus
Exocrinus moorei
Stuartwellercrinus *corbatoi*
Petschoracrinus? sp.
Parethelocrinus rectilatus
Arroyocrinus popenoei
Erisocrinus longwelli
Delocrinus *vastus*
Endelocrinus torus
Endelocrinus sp.
Graphiocrinus *copullus*
Phanocrinus? insolitus
Aatocrinus permicus
Neozeacrinus *wanneri*
Neozeacrinus coronulus
Plaxocrinus piutae
Plaxocrinus sp.
Perimestocrinus nevadensis
Perimestocrinus oasis
Stenopecrinus? xerophilus
Utharocrinus sp.
Schedexocrinus sp.
Allosocrinus quinarius
Aesiocrinus delicatulus
Aesiocrinus inornatus
Aesiocrinus nodosus
Polusocrinus amplus

Flexibles
Nevadacrinus geniculatus
Trampidocrinus phiala
Cibolocrinus *typus*

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Cibolo Limestone, middle Artinskian, west Texas, USA (Weller 1909; Moore & Plummer 1940).

Inadunates
Parulocrinus americanus
Neozeacrinus uddeni
Delocrinus quadratus
Erisocrinus propinquus
Metarrectocrinus major
Metarrectocrinus texanus
Perimestocrinus excavatus
Apographoiocrinus wolfcampensis
Spaniocrinus trinodus

Flexibles
Cibolocrinus regalis
Cibolocrinus typus

Copacabana Group, Artinskian, Bolivia (Branisia 1965; Burke 1975; Burke & Pabian 1978).

Inadunates
Aulocrinus cf. *A. agassizi*
Delocrinus cf. *D. matheri*
Delocrinus cf. *D. subhemisphericus*
Lecanocrinidae gen. et sp. indet.
Lecythiocrinus cf. *L. olliculaeformis*
Plummericrinus cf. *P. ogarai*
Axillary spines (primibrachials)
Crinoid indet. (cols)
Cibolocrinus patriciae
Cibolocrinus cf. *C. typus*

Djebel Tebaga, Wordian, Tunisia (Valette 1934; Termier & Termier 1949; 1958; Termier, Termier & Vachard 1977; Lane 1984).

Inadunates
Paragaricocrinus? yakovlevi
Tunisiacrinus imitator
Trinalicrinus tunisiensis
Strobocrinus brachiatus
Embryocrinus variabilis
Tetrabrachiocrinus fabianii
Stuartwellercrinus sp.
Tebagocrinus solignaci
Family ?Erisocrinidae, gen. et sp. indet.
Family, gen. et sp. unknown
Tetrabrachiocrinus arnouldi (col)

Sosio Limestone, Wordian, Sicily (Yakovlev 1934, 1938; Strimple & Sevastopulo 1982).

Inadunates
Basleocrinus cryptobasalis
Palermocrinus jaekeli
Agassizocrinus? striatiferus
Stachyocrinus stefaninii
Graphiocrinus fossatotuberculatus
Monobrachiocrinus siciliensis
Paragaricocrinus mediterraneus
Tetrabrachiocrinus fabianii
Metallagecrinus palermoensis

Flexibles
Cibolocrinus nodosus

Berry Formation, Wordian, New South Wales, Australia (Willink 1979a, 1979b, 1980a).

Camerates
Neocamptocrinus bundanoonensis

Inadunates
Tribrachyocrinus brogerensis
Tribrachyocrinus clarkei
Tribrachyocrinus corrugatus
Tribrachyocrinus pseudoclarkei
Tribrachyocrinus rattei
Tribrachyocrinus sp. indet.
Nowracrinus ornatus
Meganotocrinus tuberculatus